ISS 7 Soyuz/Increment 8
Stage Operations Readiness Review
Certification of Flight Readiness

Space and Life Sciences Directorate

September 24, 2003
ISS Flight 7S Stage Operations Readiness Review

Review Results

- Consensus on SLSD’s readiness to proceed with the increment was not reached and SLSD recommends corrective actions in the COFR Exception.

- Further work is required to address continued degradation in:
  - environmental monitoring system
  - exercise countermeasures system
  - health maintenance system

- Focus of further work is to mitigate on-board hardware failures, launch and return capabilities, and impacts on future ISS flights

- SLSD will assess the results of returned samples on 6S for further recommendations and forward work

- SLSD is ready to proceed with Increment 8 ISS with Program Office agreement to support forward work as noted in the exception.
Environmental Monitoring: Air Quality

• **Status**
  – ECLSS operating within baseline specifications
  – All data through the last VOA run on July 13, 2003, showed air quality meeting MORD and ISS Systems Specification requirements

• **Issues**
  – Loss of monitoring provided by the VOA and length of time between last sample and Expedition 8 limits understanding of trace gas contamination.
  – Russian monitoring does not provide sufficient insight into possible atmospheric contamination.
  – Lack of real-time monitoring capability of trace gas contaminants for Increment 8

• **Requested ISS Program Actions:**
  – Return of archival samples to provide data
    • Manifest SSAS return on 6S and 7S
    • Manifest Formaldehyde Monitor return on 6S and 7S
  – Reduce the risk of exposure to Tox 4 contaminants. (e.g. IWIS expired batteries returned on Progress or contained on ISS)
  – Reduce the risk of contaminating onboard environment (e.g. avoid EVA contamination risks)
Environmental Monitoring: Water Quality

• **Status**
  – ECLSS operating within baseline specifications
  – April 25, 2003, archival sample showed the water quality met the MORD and ISS Systems Specifications standards
  – Sampling and analysis of as-loaded water on Progress Rodnik tanks (10P-12P) show acceptable quality
  – Potential risk of protozoan contamination due to lack of appropriate filtration of ground-supplied water for Rodnik tanks – resolution pending

• **Issues**
  – Loss of monitoring provided by the Total Organic Carbon Analyzer (TOCA) and length of time since last sample and number of samples planned for Exp 8 limits understanding of water quality

• **Requested ISS Program Actions**
  – Support corrective actions for ground supplied water
  – Return of archival samples on 6S and 7S
Environmental Monitoring: Radiation

• **Status**
  – Both TEPC units hard failed beginning Expedition 5
    • Limited energy transfer data
    • No alarm capability (most important during LOS)
  – Potential that ground-tracked radiation data and forecasting from satellites will be reduced or eliminated in FY04 (NOAA)

• **Issue**
  – Lack of TEPC monitoring data and alarm capability for ALARA

• **ISS Program Action**
  – Manifest TEPC to ISS on 14P
ISS Flight 7S Stage Operations Readiness Review

Crew Exercise Capability

• **Status**
  
  – Cycle Ergometer with Vibration Isolation and Stabilization System (CEVIS)
    • March 2003 Hard disk failure in control panel
    • No automatic protocol execution; no recording of exercise data; no recording or display of heart rate
  
  – Treadmill with Vibration Isolation and Stabilization System (TVIS)
    • February 2002: Flaw in motor box trips circuit breaker
    • Motorized operations restricted to speeds less than 6 to 7 MPH
    • October 2003: Refurbished Subject Load Device (SLD) delivered with 120 day certified lifetime
  
  – IRED canister supplies to approach estimated end of life during Exp 8

• **Issues**
  
  – Expedition 8 will have 15 days of SLD usage and other limitations on TVIS use
  
  – Remediation for each problem is greater reliance on the other exercise system. This is infeasible given problems with both CEVIS, TVIS, and IRED
  
  – Continuing loss of exercise HW functionality will compromise ability to adequately sustain cardiovascular and musculoskeletal health
  
  – Possible mission impact (e.g., EVA operations; behavioral health)
  
  – Possible post-flight safety concerns (e.g., re-entry load stress; landing and egress; rehabilitation duration)

• **Requested ISS Program Actions**
  
  – Manifest sufficient IRED resupply materials to complete Increment 8
  
  – Forward work including the manifest SchRED cans by 14P
ISS Flight 7S Stage Operations Readiness Review

Health Maintenance

• **Status**
  
  – Medical Consumables
    • 8.5L out of 9L of IV fluids will expire by 3/31/04
    • Onboard medications expiration dates continue to be tracked
  
  – Defibrillator
    • Divergence between the two sensors raises concern regarding the continued capability to charge the defibrillator batteries and maintain defibrillator functionality
    • Defibrillator functionality is mandatory for advanced life support (ALS) delivery
    • Primary/alternate battery charging capability being addressed via CHIT 001167
    • Real-time cardiac monitoring and downlink was red tagged during Increment 6
    • Onboard rhythm detection/interpretation and recommendation for shock is available
  
  – 2 person medical procedures issues raised for Increments 7 and 8
    • During an emergency, one caregiver would be responsible for all monitoring and therapeutic interventions for injured crewmember; Vehicle staffing; and Soyuz prep/return

• **Issue**
  
  – Capability to provide ALS, except for “best efforts”

• **Requested ISS Program Actions**
  
  – Continue to manifest replacements for expired medications
  
  – Provide resolution on Defibrillator functionality via CHIT 001167
ISS Flight 7S Stage Operations Readiness Review

Summary

- **Open Issues:**
  - Environmental Quality Monitoring
    - Air Quality
    - Water Quality
    - Radiation
  - Crew Exercise Capability
  - Health Maintenance
- **Combination of these factors creates an increased risk to the crew that requires mitigation**
- **All open issues can be mitigated with actions identified in CoFR Exception Form:**
  - Reducing potential for exposure to environmental contaminants
  - Enhance monitoring for exposure to environmental contaminants
  - Manifesting
    - Return of environmental samples on 6S and 7S
    - Delivery of TEPC radiation monitoring device on 14P
    - Provide IRED capability to complete Increment 8 and determine long term support manifest for RED
    - Delivery of replacements for expired medications and resolve defibrillator issue per CHIT 001167
Certification of Flight Readiness Statement

The analysis, training, and operational products required to support Flight 7S launch, 6S landing and Increment 8 have been accomplished by Space and Life Sciences Directorate (SLSD). SLSD is ready to proceed with Increment 8 with the 1 exception that is noted in the package. SLSD will assess the decision for continuous operations after the successful closure of the exceptions.

SA12/C. M. Stegemoeller, Associate Director, Bioastronautics

SA13/S. A. Hawley, Associate Director, Astromaterials Research and Exploration Science (ARES)

SA14/N. R. Pellis, Associate Director, Biological Sciences and Applications

SM/C. B. Lau, Chair, Flight Activities Control Board

Concurrence by:

SA/J. R. Davis, M.D. Director, Space and Life Sciences Directorate
ISS Flight 7S Stage Operations Readiness Review

ISS CoFR EXCEPTION FORM

**EXCEPTION NUMBER:**

**LAUNCH PACKAGE NUMBER:** 7S

**INITIATING ORGANIZATION:** SA

**ENDORSEMENT CODE:**
- g. All reported HW/SW problems and non-conformances have been resolved.
- p. All operations requirements necessary for successful on-orbit operations have been defined, and the planning for implementation has been accomplished.

**EXCEPTION DESCRIPTION:**

Crew health and safety standards and requirements are contained in the MORD (SSP 50260, rev. B) and are applicable to the issues below. These issues must be addressed as described below in order to mitigate potential risks posed to Increment 8

1) **Air Quality Monitoring**
   - Loss of in-flight capability to monitor air quality, reduced number of archived samples, and period between sample assessment

2) **Water Quality Monitoring**
   - Loss of in-flight capability to monitor water quality, reduced number of archived samples, and period between sample assessment

3) **Radiation Monitoring**
   - Loss of in-flight capability for radiation dose rate alarm

4) **Exercise Capability**
   - Loss of capability to provide for adequate crew exercise

5) **Crew Health Maintenance**
   - Expired medication and loss of capability to provide Advanced Life Support, including defibrillation, correction of abnormal heart patterns, and EKG monitoring

**ACTIONEE:** OC/Cresay

**DUE DATE:** September 30

**ACTION REQUIRED TO CLOSE EXCEPTION:**

1) Verify air quality meets requirements
   - Manifest Solid Sorbent Air Sampler return on 6S and 7S
   - Manifest Formaldehyde Monitoring Kit return on 6S and 7S
   - Reduce the risk of exposure to Tox 4 contaminants. (e.g. IWIS expired batteries returned on Progress or contained on ISS)
   - Reduce the risk of contaminating onboard environment (e.g. avoid EVA contamination risks)

2) Verify water quality meets requirements
   - Manifest two high priority water samples return on 6S and 7S

3) Forward Work: Provide TEPC by 14P

4) Provide IRED capability to complete Increment 8
   - Forward work: Determine manifest support to RED for Expedition 8

5) Manifest replacement medications
   - Defibrillator issue addressed through MER chit

**INITIATOR:** B. Walters/ SM

**DATE:**

**REVIEW BOARD CHAIR:**

**DATE:**

**RESOLUTION OF EXCEPTION:**
Certification of Flight Readiness Statement

The activities required to support Flight 7S launch, 6S landing and Increment 8 have been accomplished by Space and Life Sciences Directorate’s (SLSD) FACB. SLSD is ready to proceed with the Increment 8 with the 2 exceptions that are noted in the package. SLSD will assess the decision for continuous operations after the successful closure of the exceptions.

The FACB did not have unanimous agreement on the readiness to proceed with the increment, which are noted below.

J. B. Walters, SM, Deputy Chief Mission and Project Management Office

W. Paloski SK, Chief Human Adaptation and Countermeasures Office

J. Homick SL, Chief, Program Integration Office

M. Anderson SJ, Chief Biological Systems Office

Susan K. Byrne SX, Assistant Mgr, Office of Human Exploration Science

The continued degradation in the environmental monitoring system, exercise countermeasures system, and the health maintenance system coupled with a planned increment duration of greater than 6 months, and extremely limited resupply, all combine to increase the risk to the crew to a point where initiation of Increment 8 is not recommended.

W. Langdoc SF, Chief Habitability and Environmental Factors Office

N. Cintron SD, Chief Space Medicine and Health Care System Office
Backup Charts:
ISS Presentation Format
A. Baseline for Evaluation
   - Critical Assumptions
B. First Flight Items - N/A
C. First Operations Items
D. Critical Process or Operations Changes
E. Risks
F. Planned Forward Work
G. Standard Open Work
H. Exceptions
I. Significant Open Issues
J. Readiness Statement for Endorsement Codes
K. CoFR Certificate
L. Delegation of Authority Letters - in backup slides
M. Back-Up Information
A. Baseline for Evaluation & Critical Assumptions

- Program documents and assumptions presented by the Increment 8 Manager

- Additional documentation utilized for Increment 8 analysis
  - Space and Life Sciences Directorate Certification of Flight Readiness Implementation Plan (JSC 28225, rev. B) and CoFR Web Based Application
  - Segment Specification for the USOS (SSP 41162)

- Critical assumptions for SLSD to CoFR the entire Increment
  - SSAS, 2 water samples and Formaldehyde Monitors are returned on 6S
  - IWIS used batteries are disposed of or contained prior to the expiration date
  - TEPC and SchRED are delivered to ISS on 14P
  - Other critical medical/environmental hardware is manifested on 13P, 14P, and 15P and these flights launch per the schedule-forward work
• Increment 8 Orlan EVA #9 with 2 crewmembers
  – Planned forward work presented in section F
ISS Flight 7S Stage Operations Readiness Review

D. Critical Process or Operations Changes

• Critical workarounds

  – Using onboard BP/ECG monitor in lieu of Defibrillator ECG downlink due to PDIM failure. BP/ECG was not designed for this function.

  – Using archive samples for water and air samples in lieu of onboard monitoring during Increment

  – Reduced frequency of returned water and air samples for analysis due to limited downmass which does not allow verification of environment.

  – Crewmembers are exercising at reduced speeds on TVIS and reduced cycles on the IRED which impacts crew physical condition necessary for EVA and landing scenarios

  – Advanced Life Support procedures (i.e. intubation, ventilation, administration of IV fluids, defibrillation, etc) are difficult to perform with one caregiver and may result in delayed medical care and a poor or undesirable outcome.
ISS Flight 7S Stage Operations Readiness Review

E. Risks

• ISS Risks previously identified and accepted by the ISS Program (included in backup slides):
  
  – 4707, ISS REPLAN - Environmental Health System - Air Quality Monitoring; Flights Affected: 6S, 7S, Progress
  – 4615, ISS Plan for Mitigating ISS Crew Health and Safety Risks; Flights Affected: Progress
  – 4487, Microbial Contamination of ISS Water System; Flights Affected: Progress

• ISS Watch Items:
  
  – 4718, ISS Replan - Environmental Health - Radiation Monitoring; Flights Affected: 11P, 14P, 6S, Progress
  – 4706, ISS Replan - Environmental Health Water Quality Monitoring; Flights Affected: 6S, 7S
F. Planned Forward Work

• Work with EVA prior to EVA #9 to ensure external contamination sources will be avoided by the crew; ECD: 12/03

• Evaluate 2 crew Orlan suit EVA-related medical emergencies and ensure plans are in place to address risk; ECD: 12/03

• Work with Increment Team on 13P, 14P, and 15P manifest to ensure critical medical/environmental equipment is accommodated; ECD: Per Increment Team schedule

• Evaluate development and manifesting of critical items to improve current onboard hardware functionality (i.e. ammonia monitors to detect trace amounts in the environment due to leaks in coolant loops, microbial kits to detect microbes in the water systems); ECD: Post Increment 8
G. Standard Open Work

- Final crew physicals will be performed at GCTC on L-10 days

- Finalize mission support shifts for launch, mission, and landing in US and Russia, along with cell/satellite phone numbers
ISS Flight 7S Stage Operations Readiness Review

H. Exceptions

• Requirements in the GGR&C, MORD and the USOS Specification are not being met.

• Program accepted GGR&C waivers in the Increment 8 IDRD:
  – 3.2.4 Crew On-orbit Stay Time
  – 3.3.2.2.5 Medical Operations

• One exception identified for the 7S Stage since requirements documented in the MORD and Segment Spec for the USOS are not being met
I. Significant Open Issues

- Reduced CHeCS hardware functionality compromises the crew surgeon’s ability to assess and diagnose crew health.

- Return of mandatory samples to the US for analysis in a timely manner.
ISS Flight 7S Stage Operations Readiness Review

J. Readiness Statement for Endorsement Codes

a. US food rations have been delivered to Russia for 7S; remaining deliveries for 13P-15P are forward work. Exception: Operation of defibrillator
b. US food rations are built to applicable specifications and drawings
c. All SLSD hardware launching on 7S has been delivered to Russia
d. N/A for 7S - no ground processing requirements
e. Limited life hardware has been identified to OB who is responsible for tracking
f. SA participated in the FORs, JOPs and SARs (for CHeCS equipment)
g. No open items for SLSD hardware
h. Risks and watch items have been identified to the ISS Program
i. Constraints for 7S stage have been identified; additional risk mitigation activities are forward work
j. Critical manifested items have been identified and are on current 7S launch/6S return manifest
k. N/A for 7S - no changes
l. All personnel are trained to work in the MCC-H and MCC-M (medical ops, imagery, radiation ops, management); plans are in place for Medevac support in Russia
m. Flight rules and crew procedures have been reviewed and are up to date
n. All personnel are trained to support the mission
o. Software loads (MEC CD) have been verified and delivered; HRF PCMCIA card has been verified and delivered
p. Operations requirements have been identified in IDRD and IDRD Annexes 2, 3, 4
q. N/A for 7S
### ISS Flight 7S Stage Operations Readiness Review

#### Summary of Environmental Monitoring

<table>
<thead>
<tr>
<th>Requirements Area</th>
<th>Date and result of last analysis</th>
<th>Yellow/Red for 6S/7S</th>
<th>What has changed</th>
<th>What is required to maintain continuous on-orbit operations?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Monitoring</strong></td>
<td>Last archive air sample on 12/16/02. VOA ops until 7/13/03. Results show atmosphere quality meets requirements.</td>
<td>Y/Y</td>
<td>Loss of VOA on 7/13/03</td>
<td>Launch of SSAS on 12P (done) and return of SSAS on 6S. Return of FMK on 6S. Expedited processing of SSAS and FMK at JSC to provide preliminary report at JSC return + 10 business days. All samples identified are on the current NASA manifest. Launch of SSAS on 13P (planned) and return on 7S along with FMK. Expedited processing of SSAS and FMK at JSC to provide preliminary report at JSC return + 10 business days.</td>
</tr>
<tr>
<td><strong>Water Monitoring</strong></td>
<td>Last archive water sample on 4/25/03. Results show water quality meets requirements</td>
<td>Y/Y</td>
<td>Nothing</td>
<td>Return of 2 water samples on 6S. Expedited return of SSAS from Energia. Russian water sampling and analytical methods do not meet quality requirements. Samples identified are on the current NASA manifest. No agreement will be available from the Russians until after the 6S Program SORR.</td>
</tr>
<tr>
<td><strong>Acoustics</strong></td>
<td>2 Sound level surveys and 6 audio dosimetry sessions have occurred during Inc 7 and more are planned. Results still show elevated levels in the RS.</td>
<td>Y/Y</td>
<td>Nothing</td>
<td>Continuation of sound level surveys and audio dosimetry testing. Initiation of remedial action plan must start during Increment 8.</td>
</tr>
<tr>
<td><strong>Microbiology</strong></td>
<td>Last on-orbit sampling 8/25/03. Results show SVO-ZV potable water storage system is still contaminated. However, cannot determine degree of contamination with current monitoring hardware</td>
<td>Y/Y</td>
<td>Additional silver concentrate available for decontamination of SVO-ZV</td>
<td>Certify and launch upgraded water microbiology kit including coliform detection capability by 14P. Certify and launch complete upgrades, including increased enumeration capability on 15P. Disinfect SVO-ZV system at the earliest opportunity and verify effectiveness.</td>
</tr>
<tr>
<td><strong>Radiation</strong></td>
<td>Continued operations with IV and EV-CPDS. Continued coverage of crewmember dose via dosimetry. Currently coming out of Solar max</td>
<td>Y/Y</td>
<td>Nothing</td>
<td>Launch TEPC on 14P.</td>
</tr>
</tbody>
</table>
## ISS Flight 7S Stage Operations Readiness Review

**Cycle Ergometer with Vibration Isolation and Stabilization System (CEVIS)**

<table>
<thead>
<tr>
<th>Requirements Area</th>
<th>Date and results of your last Analyses</th>
<th>Yellow or Red for 6S SORR/ Yellow or Red for the 7S SORR</th>
<th>What has changed from the 6S SORR to the 7S SORR that were instrumental in your assessment (e.g., equipment x failed)?</th>
<th>What is required to maintain continuous on-orbit operations (by flight or date)? Note: if Russian equipment, samples cannot be used, state why</th>
<th>What is on the current manifest (by flight)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic Exercise CEVIS</td>
<td>March 23, 2003: IFM workaround connects external Power Supply and ScopeMeter to compensate for failed hard disk in controller</td>
<td>Y/Y</td>
<td>No Change</td>
<td>Current CEVIS operations will support routine crewmember exercise; Periodic Fitness Evaluations; and EVA EMU Pre-Breathe Protocol. Russian VELO Ergometer will support crew exercise, but will not support: (i) Periodic Fitness Evaluations or (ii) EVA EMU Pre-Breathe Protocol.</td>
<td>7S: New seat back cover 13P: New isolators</td>
</tr>
</tbody>
</table>

**March 1, 2003 -- CEVIS failed to boot up on power up**

Ø No automatic execution of protocols  
Ø No recording of exercise data  
Ø No recording or display of heart rate
### ISS Flight 7S Stage Operations Readiness Review

**Treadmill with Vibration Isolation and Stabilization System (TVIS)**

<table>
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</table>
| **Aerobic and locomotion TVIS** | 45 days of life remain on SLDs (30 days allocated for Expedition 7) | Y/Y | No Change  
→ motorized operations restricted to speeds < 6 - 7 mph (crewmember dependent)  
→ loading provided by Series Bungee System (SBS) for all but the final 30 days | [Russian BD-1 expected to be manifested on Progress 15. However, the BD-1 to TVIS Interface Adapter is not yet fabricated and not manifested.] | 7S: 2 Harnesses  
14P: 2 Harnesses (for Expedition 9); 2 new PCMCIA cards |

**October 5, 2003 – ISS 9A/STS 112: Refurbished Build-to-Print Subject Load Devices (SLDs) swapped for failed units**

Ø 120-day lifetime (based on performance of two previous sets of SLDs)

Ø TVIS loading provided by Series Bungee System (SBS) for all but the final 30 days of Expedition 7

**February 26, 2002: Design Flaw in Motor Box Uncovered: Operations at high speed trip circuit breaker**

Ø Motorized operations restricted to speeds less than 6 - 7 mph (crewmember dependent)

**Ongoing Issue:** TVIS PCMCIA cards continue to periodically loose data
ISS Flight 7S Stage Operations Readiness Review
Interim Resistive Exercise Device (IRED)

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<th>Yellow or Red for 6S SORR/ Yellow or Red for the 7S SORR</th>
<th>What has changed from the 6S SORR to the 7S SORR that were instrumental in your assessment (e.g., equipment x failed)?</th>
<th>What is required to maintain continuous on-orbit operations (by flight or date)?</th>
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<th>What is on the current manifest (by flight)?</th>
</tr>
</thead>
</table>
| Resistive Exercise IRED | G-/G-                                      |                                                 |                                                                                                    |                                                                                   |                                                                                  | 7S: 9 flexpacks
14P: SchRED canisters |

**Expedition 7: Restrictions in Usage to Preserve Assets**
Ø Weekly cycles are restricted to less than 2800 until final 30 days of Expedition
Ø Weekly cycles are restricted to less than 3500 for final 30 days of Expedition

**Expedition 8: Restrictions in Usage to Preserve Assets**
Ø Weekly cycles are restricted to less than 2800 until Progress 14 when SchRED canisters are scheduled to be delivered
<table>
<thead>
<tr>
<th>Requirements Area</th>
<th>Date and results of your last Analyses</th>
<th>Yellow or Red for 6S SORR/ Yellow or Red for the 7S SORR</th>
<th>What has changed from the 6S SORR to the 7S SORR that were instrumental in your assessment (e.g., equipment x failed)?</th>
<th>What is required to maintain continuous on-orbit operations (by flight or date)?</th>
<th>What is on the current manifest (by flight)?</th>
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</table>
| DEFIB             | PDIM has never provided uncorrupted, real-time DEFIB data to the ground  
3/6/03: PDIM charging DEFIB battery at anomalously high frequency  
5/7/03: New DEFIB battery charging procedure using PDIM documented in CHIT ISS0091  
6/03: DEFIB BIT summary data indicates increasing diverging values of 2 current measurements  
9/18/03: Chit 001167 opened to investigate anomaly | Y/Y | DEFIB PDIM Built-In-Test (BIT) indicates unknown, growing anomaly with charging of batteries | Must resolve this anomaly such that there is assurance that the DEFIB will function throughout the Increment. Either (1) the BIT data is proved to be erroneous (i.e., failed sensor) or (2) alternate means are available onboard for charging the DEFIB batteries | No hardware manifested |